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Enteric Coated Tablets Incresses The Solubility Of Hydrophobic Drug

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Abstract:

Enteric coated tablets are solid unit dosage forms intended for oral delivery; they are made to avoid the stomach and release the medication in the small intestine instead. The word “enteric” indicates small intestine; therefore enteric coatings prevent release of medication before it reaches the small intestine. Most enteric coatings work by presenting a coated surface that is stable at the highly acidic pH found in the stomach, but breaks down rapidly at a less acidic (relatively more basic) pH. Enteric coating materials consist of fatty acids, waxes, shellac, polymers, plant fibers, CAP, CAT, PVAP, and HPMCP. This study discusses enteric coating, including its optimal qualities, advantages, and disadvantages. It also discusses the different polymers utilized, their chemical structures, drug selection and mechanism criteria, and the production and assessment processes for enteric coated tablets. Due to their advantages over traditional drug delivery methods, which include longer dose intervals and higher patient compliance, these have recently piqued the interest of several formulators. The study provides an overview of the recent advances in enteric coated tablet.

Keywords: Coating Process, Evaluation, Enteric coated tablet, Methods of Enteric Coated, ideal characteristic.

INTRODUCTION

A tablet is a solid dosage form made by compressing an active pharmaceutical ingredient (API) with excipients.[1] To enhance functionality, coating is often applied, offering benefits such as controlled release, protection from stomach acid, and improved patient compliance. An enteric coating is a specialized polymer barrier applied to tablets that: Prevents drug release in the stomach (low pH). Allows dissolution in the intestine (higher pH), where absorption occurs. Mechanism of Action: At low pH (stomach): coating remains unionized and insoluble.[2] At higher pH (intestine): acidic groups in the polymer ionize, making the coating swell or dissolve, releasing the drug. Common Enteric Coating Materials: Natural and synthetic: Shellac, waxes, fatty acids, plant fibers. Polymers:Cellulose acetate phthalate (CAP) Cellulose acetate trimellitate (CAT) Poly(vinyl acetate phthalate) (PVAP) Hydroxypropyl methylcellulose phthalate (HPMCP) Poly(methacrylic acid-co-methyl methacrylate)

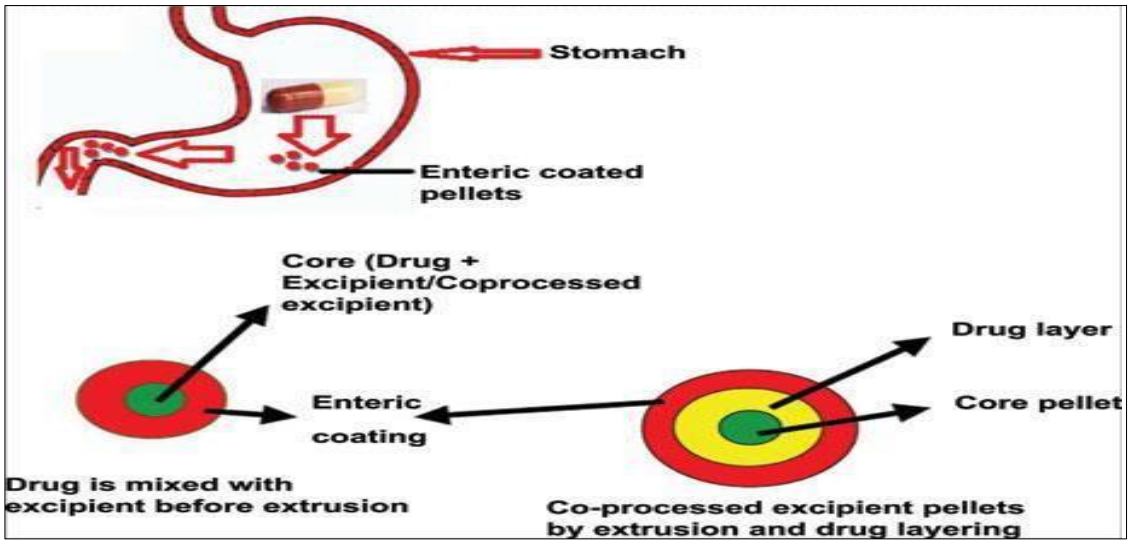

Figure no 1. Physiological concepts of the gastrointestinal absorption

TABLET COATING

Coating is a process by which an essentially dry, outer layer of coating material is applied to the surface of a dosage form in order to confer specific benefits that broadly ranges from facilitating product identification to modifying drug release from the dosage form. After making a good tablet, one must often coat it.[3] Coating may be applied to multiple range of oral solid dosage form, including tablets, capsules, multiparticulates and drug crystals. When coating composition is applied to a batch of tablets in a coating pan, the tablet surfaces become covered with a tacky polymeric film.[4] Before the tablet surface dries, the applied coating changes from a sticky liquid to tacky semisolid and eventually to a non-sticky dry surface pans.[5] The entire coating process is conducted in a series of mechanically operated acorn-shaped coating pans The applied coating transforms from a sticky liquid to a tacky semisolid and then to a non-sticky dry surface before the tablet surface dries. Throughout the entire coating process, a sequence of mechanically driven, acorn-shaped coating pans composed of copper, stainless steel, or galvanized iron are employed.[6] Larger pans are employed for industrial production, whereas smaller pans are utilized for pilot plant, experimental, and developmental operations.[7]

Components of tablet coating

1. Tablet properties
2. Coating process
3. Coating equipments
4. Parameters of the coating process
5. Facility and ancillary equipments
6. Automation in coating processe

The enteric coating is an outer coating that can be used in oral pharmaceutical dosage forms, and is usually made up of synthetic polymers or natural products.[8] There are numerous possible motivations for using enteric coating, including altering the odor or taste of the drug adding protection against environmental conditions (especially pH), the protection of gastric mucosa against the irritating action of some drugs or allowing for site or time specific drug release.[9] The enteric coating prevents the delivery of a drug in the stomach but permits release of the drug in the small intestine. To achieve this, a polymer insoluble at acid pH but soluble at intestinal pH is used. When the drug reaches the upper small intestine, the coating dissolves allowing drug release. The polymers commonly used to obtain enteric coatings are, among others, cellulose acetate phthalate, methacrylic acid copolymers and hydroxypropyl methylcellulose phthalate.[10] Technological procedures that can be used for these types of covers include film coating and sugar coating. The weight of the enteric polymer should be sufficient to ensure that the intended effect is achieved. Usually, the amount of polymer used in enteric coating is double or triple that used for a normal coating.

Enteric coatings are involve two steps : 1. To preserve the drug from degradation of acidic pH and enzymes that can occur in the stomach. 2. To protect the stomach from the undesirable effects of a drug

Mechanism of enteric coated tablet:

ETP (Enteric-coated Time-controlled Pulsatile) Tablets – Summary Structure: ETP tablets have three distinct layers: Core Tablet – Contains the drug; designed for rapid release. Press-coated Layer – Made of hydrophobic,[11] swellable polymer (e.g., Hydroxypropyl Cellulose, HPC) for time-controlled release.[12] Enteric Coating – Provides acid resistance to prevent drug release in the stomach. Mechanism of Action: In the Stomach: The enteric coating prevents drug release due to its resistance to acidic pH. After Gastric Emptying: [13]The enteric layer dissolves in intestinal fluid. The intestinal fluid then slowly erodes the HPC layer. Once erosion reaches the core, the drug is rapidly released. [14]Lag Phase: The time delay before drug release (lag phase) occurs after gastric emptying. The duration of the lag phase is controlled by the weight and composition of the HPC layer. Purpose: Designed for pulsatile drug delivery, ideal for drugs needing time-specific release, such as chronotherapeutic medications.[15]

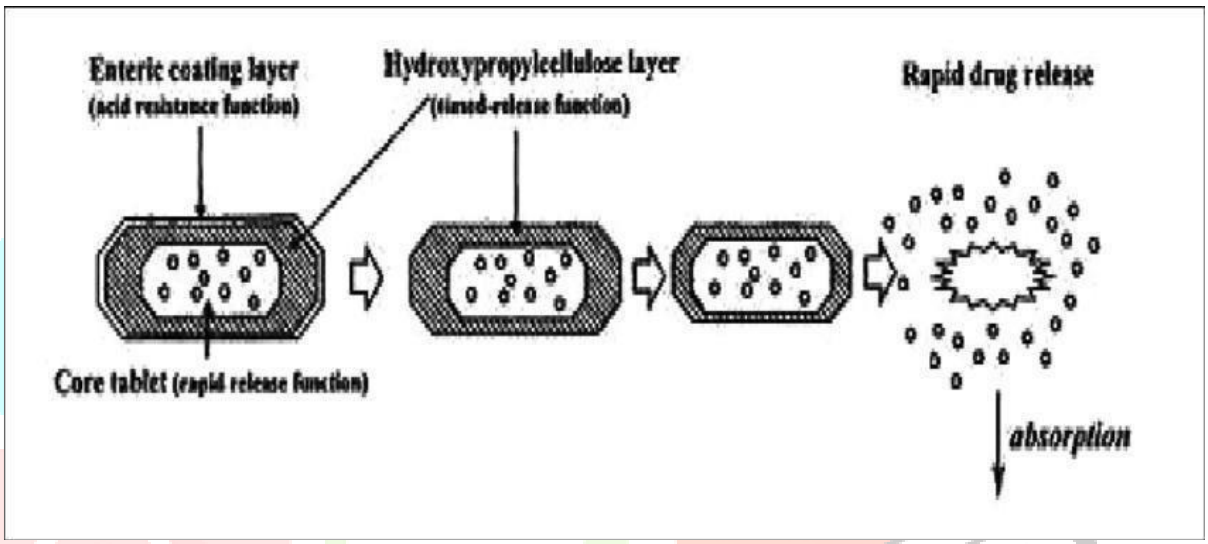

Figure no 2: Mechanism of Entric coating tablet

Ideal characteristic enteric coating material[16]

1. Resistance to gastric fluids

2. Susceptible/permeable to intestinal fluid

3. Compatibility with most coating solution components and the drug substrate

4. Formation of continuous film

5. Nontoxic, cheap and ease of application

6. Ability to be readily printed

Advantages of tablet coating:-

1. Tablet coatings must adhere to the intricate shapes of embossed characters or logos on tablets, avoid causing the tablets to clump together during the coating process, and be sturdy and stable enough to withstand handling.[17]
2. Coatings can also be used to print on tablets if needed. Tablet coatings are required to provide a smoother finish, make big pills simpler to swallow, and cover up an unpleasant flavor[18]

3. Process of Coating

Tablet coating takes place in a controlled atmosphere inside a perforated rotating drum. Once batch of tablets were loaded into the coating pan, preheat the tablets and allow time for dust and tablet flash to exit the pan.[19] Angled baffles fitted into the drum and air flow inside the drum provides means of mixing the tablet bed. As a result, the tablets are lifted and turned from the sides into the centre of the drum, exposing each tablet surface to an even amount of deposited/sprayed coating.[20] Once the temperature of the outlet air reaches 42°C to 46°C, usually within 15 minutes, spraying can begin.The spray guns create a fine mist of coating solution that dries just after it contacts the tablet.[21] The liquid spray coating dried onto the tablets by heated air drawn through the tablet bed from an inlet fan.[22] The air flow is regulated for temperature and volume to provide controlled drying and extracting rates, and at the same time, maintaining the drum pressure slightly negative relative to the room in order to provide a completely isolated process atmosphere for the operator.As the water evaporates, it leaves the solids behind to form a thin film on the tablet. The key to tablet coating is to get the surface slightly wet and immediately dry. Apply the coating in many short, fast exposures, not in long, slow exposures.Once the base coating is applied, you can increase the rate of solution addition and the pan speed proportionately. Typically, it takes about 20 minutes before increasing the spray rate and pan speed significantly. Tablets that are very porous may require an initial spray rate that is slower than the average of 100 millilitres per minute per gun.[23] Be sure to monitor spraying to see whether the spray pattern changes. If it does, there is likely a build-up of solids on the gun tips. Correct thisonly by cleaning the tips, which means stopping the spray and the pan. The enteric coating solution dries on the tablet surface because there is a constant supply of hot air entering the drum and passing through the drum perforations into the bed of tablets. Over time, the film builds layer after layer of solids. After finished applying the solution and drying it, the tablets must cool. For coatings to adhere properly, the tablets must remain at a specific temperature, the solution must be applied at a consistent rate, and the motion of the tablets must be active yet tranquil. Disrupt any of these conditions, and this will produce a defective tablet.[24]

Evaluation of Core and Coated Tablet:

The core and coated tablets were evaluated for hardness, friability, weight variation, disintegration time, thickness, drug content and in vitro release studies.

1. **Hardness:**
   The tablet crushing strength was measured by using Monsanto tablet hardness tester. A tablet is placed between the anvils and the crushing strength, which causes the tablet to break, was recorded[25]
2. **Friability Tablet strength:**
   was tested by Roche friabilator. Twenty tablets were accurately weighed and placed in the friabilator and operated for 100 revolutions in 4 min. The tablets were dedusted and the percentage weight loss was calculated by reweighing the tablets. The tablets that loose less than 1% weight were considered to be compliant.[26]
3. **Weight variation:**
   In weight variation, twenty tablets were selected at random and average weight was determined using an electronic balance. Tablets were weighed individually and compared with average weight.[27]
4. **Disintegration time:**
   Disintegration time was determined using the disintegration apparatus USP in 0.1N HCl for 2 hrs. and then in phosphate buffer pH 6.8 for 1 hour maintaining the temperature at 37± 2°C.
5. **Thickness:**
   The thickness of the tablet was measured by using vernier calipers.
6. **Drug content studies:**
   Ten tablets were weighed individually and powdered; an amount equivalent to 5 mg of drug was taken and 50ml of 95% ethanol was added and was shaken for 30 minutes. Sufficient ethanol (95%) was added to produce 100ml. It was centrifuged and suitable volume of the supernatant liquid equivalent to 0.5mg of drug was pipette out and diluted to 50ml with 95% ethanol. The solution was filtered (through 0.45µm). Drug content was measured at 236nm using UV/Visible single beam spectrophotometer.
7. **In vitro drug release studies:**
   In gastric and intestinal pH in vitro drug release study of enteric coated tablets was carried out by using USP XXIV six station dissolution rate test apparatus with paddle stirrer. The dissolution rate was studied in 900 ml of 0.1 N HCl (pH 1.2) maintained at a temperature of 37±1ºC with a speed of 50rpm for first two hours followed by phosphate buffer (pH 7.4) for further four hours. Samples of

5ml were withdrawn after every hour, filtered (through 0.45µm) and replaced with 5ml of fresh dissolution medium. The samples were suitably diluted if necessary and estimated spectrophotometrically at 236nm by using UV/Visible single beam spectrophotometer and cumulative percentage drug release was calculated

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